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DeHaan

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(54) **MESSAGE-BASED INSTALLATION MANAGEMENT USING MESSAGE BUS**

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(52) **U.S. Cl.**
CPC ***G06F 8/61*** (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,787,246 A 7/1998 Lichtman et al.
5,835,719 A 11/1998 Gibson et al.
5,948,062 A 9/1999 Tzelnic et al.
6,105,100 A 8/2000 Dean et al.
6,212,585 B1 4/2001 Chrabaszcz
6,243,747 B1 6/2001 Lewis et al.
6,266,809 B1 * 7/2001 Craig et al. 717/173
6,272,536 B1 8/2001 van Hoff et al.
6,381,742 B2 4/2002 Forbes et al.
6,415,289 B1 7/2002 Williams et al.
6,438,711 B2 8/2002 Woodruff
6,516,427 B1 2/2003 Keyes et al.
6,526,442 B1 2/2003 Stupek et al.
6,550,021 B1 4/2003 Dalphy et al.
6,557,169 B1 4/2003 Erpeldinger
6,594,664 B1 7/2003 Estrada et al.
6,625,742 B1 9/2003 Owhadi et al.
6,686,638 B2 2/2004 Rezvani et al.
6,751,659 B1 6/2004 Fenger et al.
6,757,837 B1 6/2004 Platt et al.
6,769,022 B1 7/2004 DeKoning et al.
6,779,004 B1 8/2004 Zintel
6,845,464 B2 1/2005 Gold
6,865,737 B1 3/2005 Lucas et al.
6,947,939 B2 9/2005 Fujibayashi et al.
6,986,033 B2 1/2006 Miyamoto et al.
7,013,461 B2 * 3/2006 Hellerstein et al. 717/177
7,051,101 B1 5/2006 Dubrovsky et al.
7,107,330 B1 9/2006 Hamilton et al.
7,133,822 B1 11/2006 Jacobson
7,165,109 B2 1/2007 Chiloyan et al.
7,185,071 B2 2/2007 Berg et al.
7,200,845 B2 4/2007 Morrison et al.
7,293,169 B1 * 11/2007 Righi et al. 713/2
7,340,637 B2 3/2008 Nagoya
7,350,112 B2 3/2008 Fox et al.

(Continued)

OTHER PUBLICATIONS

HP Storage Essentials SRM 6.0 Installation Guide. Jan. 2008. HP. 1st ed. Part No. T4283-96113. pp. 1-5, 97-136, 219-228.

(Continued)

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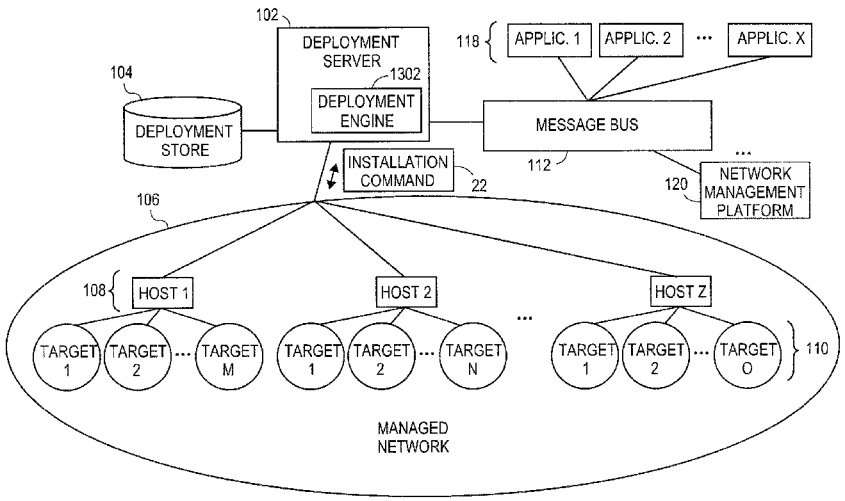
(57) **ABSTRACT**

Embodiments relate to message-based installation management using a message bus. In embodiments, a deployment server or other provisioning host can be connected to a resource via a message bus. A processor monitors the bus message traffic to detect a message activity. The processor generates an installation command to cause a software installation in a managed network in view of the message activity detected on the message bus.

22 Claims, 4 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

7,356,679 B1 4/2008 Le et al.
7,395,322 B2 7/2008 Harvey et al.
7,506,040 B1 3/2009 Rabe et al.
7,506,151 B2 3/2009 Miyamoto et al.
7,516,218 B2 4/2009 Besson
7,519,691 B2 4/2009 Nichols et al.
7,574,481 B2 8/2009 Moore et al.
7,600,005 B2 10/2009 Jamkhedkar et al.
7,606,868 B1 10/2009 Le et al.
7,640,325 B1 12/2009 DeKoning et al.
7,681,080 B2 3/2010 Abali et al.
7,716,316 B2 5/2010 Nichols et al.
7,734,717 B2 6/2010 Saarimaki et al.
7,827,261 B1 11/2010 Griswold et al.
7,831,997 B2 11/2010 Eldar et al.
7,937,437 B2 5/2011 Fujii
2002/0062259 A1 5/2002 Katz et al.
2002/0078186 A1 6/2002 Engel et al.
2002/0138567 A1 9/2002 Ogawa
2002/0162028 A1 10/2002 Kennedy
2003/0005097 A1 1/2003 Barnard et al.
2003/0055919 A1 3/2003 Fong et al.
2003/0069884 A1 4/2003 Nair et al.
2003/0069946 A1 4/2003 Nair et al.
2003/0070110 A1 4/2003 Aija et al.
2003/0074549 A1 4/2003 Paul et al.
2003/0110173 A1 6/2003 Marsland
2003/0119480 A1 6/2003 Mohammed
2003/0126585 A1 7/2003 Parry
2003/0195921 A1 10/2003 Becker et al.
2003/0200272 A1* 10/2003 Campise et al. 709/206
2003/0212992 A1 11/2003 Ronning et al.
2004/0006616 A1 1/2004 Quinn et al.
2004/0015831 A1 1/2004 Bowhill
2004/0015957 A1 1/2004 Zara et al.
2004/0019876 A1 1/2004 Dravida et al.
2004/0024984 A1 2/2004 Lanzatella et al.
2004/0044643 A1 3/2004 deVries et al.
2004/0054789 A1 3/2004 Breh et al.
2004/0059703 A1 3/2004 Chappell et al.
2004/0064501 A1 4/2004 Jan et al.
2004/0128375 A1 7/2004 Rockwell
2004/0143664 A1 7/2004 Usa et al.
2004/0167975 A1 8/2004 Hwang et al.
2004/0215755 A1 10/2004 O'Neill
2004/0223469 A1 11/2004 Bahl et al.
2004/0243996 A1* 12/2004 Sheehy et al. 717/174
2005/0028025 A1 2/2005 Zalewski et al.
2005/0050175 A1 3/2005 Fong et al.
2005/0114474 A1 5/2005 Anderson et al.
2005/0125525 A1 6/2005 Zhou et al.
2005/0177829 A1 8/2005 Vishwanath
2005/0182796 A1 8/2005 Chu et al.
2005/0198629 A1 9/2005 Vishwanath
2005/0223374 A1 10/2005 Wishart et al.
2006/0041767 A1 2/2006 Maxwell et al.
2006/0080659 A1 4/2006 Ganji
2006/0095230 A1 5/2006 Grier et al.
2006/0095702 A1 5/2006 Hickman et al.
2006/0155857 A1 7/2006 Feenan et al.
2006/0168581 A1* 7/2006 Goger et al. 717/174
2006/0173912 A1 8/2006 Lindvall et al.
2006/0174018 A1 8/2006 Zhu et al.
2006/0190575 A1 8/2006 Harvey et al.
2006/0190773 A1 8/2006 Rao et al.
2006/0200658 A1 9/2006 Penkethman
2006/0215575 A1 9/2006 Horton et al.
2006/0218544 A1 9/2006 Chakraborty et al.
2006/0230165 A1 10/2006 Zimmer et al.
2006/0282479 A1 12/2006 Johnson et al.
2007/0015538 A1 1/2007 Wang
2007/0067419 A1 3/2007 Bennett
2007/0101118 A1 5/2007 Raghunath et al.
2007/0118654 A1 5/2007 Jamkhedkar et al.
2007/0168721 A1 7/2007 Luiro et al.
2007/0169093 A1 7/2007 Logan et al.
2007/0192158 A1 8/2007 Kim
2007/0204338 A1 8/2007 Aiello et al.
2007/0226810 A1 9/2007 Hotti
2007/0244996 A1 10/2007 Ahmed et al.
2007/0276905 A1 11/2007 Durand et al.
2007/0288612 A1 12/2007 Hall
2007/0294376 A1 12/2007 Ayachitula et al.
2007/0299951 A1 12/2007 Krithivas
2008/0028048 A1 1/2008 Shekar et al.
2008/0040452 A1 2/2008 Rao et al.
2008/0046708 A1 2/2008 Fitzgerald et al.
2008/0059959 A1 3/2008 Chen et al.
2008/0130639 A1 6/2008 Costa-Requena et al.
2008/0148409 A1* 6/2008 Ampunan et al. 726/26
2008/0168424 A1* 7/2008 Mohindra et al. 717/120
2008/0172664 A1* 7/2008 Nduaguba et al. 717/174
2008/0189693 A1 8/2008 Pathak
2008/0196043 A1 8/2008 Feinleib et al.
2008/0235266 A1 9/2008 Huang et al.
2008/0235361 A1 9/2008 Crosbie et al.
2008/0244325 A1 10/2008 Tyulenev
2008/0270674 A1 10/2008 Ginzton
2008/0288938 A1 11/2008 DeHaan
2008/0288939 A1 11/2008 DeHaan
2008/0294777 A1 11/2008 Karve et al.
2008/0301666 A1 12/2008 Gordon et al.
2008/0313716 A1 12/2008 Park
2008/0320110 A1 12/2008 Pathak
2009/0007091 A1 1/2009 Appiah et al.
2009/0055901 A1 2/2009 Kumar et al.
2009/0064132 A1 3/2009 Suchy et al.
2009/0089567 A1 4/2009 Boland et al.
2009/0089852 A1 4/2009 Randolph et al.
2009/0106291 A1 4/2009 Ku et al.
2009/0129597 A1 5/2009 Zimmer et al.
2009/0132682 A1 5/2009 Counterman
2009/0132710 A1 5/2009 Pelley
2009/0158148 A1 6/2009 Vellanki et al.
2009/0158272 A1 6/2009 El-Assir et al.
2009/0164522 A1 6/2009 Fahey
2009/0165099 A1 6/2009 Eldar et al.
2009/0172430 A1 7/2009 Takenouchi
2009/0217163 A1* 8/2009 Jaroker 715/700
2009/0240835 A1 9/2009 Adelman et al.
2009/0259665 A1 10/2009 Howe et al.
2009/0265707 A1 10/2009 Goodman et al.
2009/0282404 A1 11/2009 Khandekar et al.
2009/0285199 A1 11/2009 Strahs et al.
2010/0023740 A1 1/2010 Moon et al.
2010/0049838 A1 2/2010 DeHaan
2010/0050169 A1 2/2010 DeHaan
2010/0054156 A1 3/2010 DeHaan
2010/0057390 A1 3/2010 DeHaan
2010/0057833 A1 3/2010 DeHaan
2010/0057913 A1 3/2010 DeHaan
2010/0057930 A1 3/2010 DeHaan
2010/0058307 A1 3/2010 DeHaan
2010/0058327 A1 3/2010 DeHaan
2010/0058328 A1 3/2010 DeHaan
2010/0058330 A1 3/2010 DeHaan
2010/0058332 A1 3/2010 DeHaan
2010/0058444 A1 3/2010 DeHaan
2010/0082799 A1 4/2010 DeHaan et al.
2010/0083245 A1 4/2010 DeHaan et al.
2010/0100876 A1 4/2010 Glover et al.
2010/0128639 A1 5/2010 DeHaan et al.
2010/0131646 A1 5/2010 Drako
2010/0138521 A1 6/2010 DeHaan et al.
2010/0138526 A1 6/2010 DeHaan et al.
2010/0138696 A1 6/2010 DeHaan et al.
2010/0217837 A1 8/2010 Ansari et al.
2010/0217840 A1 8/2010 DeHaan et al.
2010/0217843 A1 8/2010 DeHaan et al.
2010/0217848 A1 8/2010 DeHaan et al.
2010/0217944 A1 8/2010 DeHaan et al.
2010/0218243 A1 8/2010 DeHaan et al.
2010/0220584 A1 9/2010 DeHaan et al.
2010/0223367 A1 9/2010 DeHaan

(56) **References Cited**

U.S. PATENT DOCUMENTS

2010/0223504	A1	9/2010	DeHaan et al.	
2010/0223607	A1	9/2010	DeHaan	
2010/0223608	A1	9/2010	DeHaan et al.	
2010/0223609	A1	9/2010	DeHaan et al.	
2010/0223610	A1	9/2010	DeHaan et al.	
2010/0281456	A1*	11/2010	Eizenman et al.	717/104

OTHER PUBLICATIONS

HP Storage Essentials SRM 6.0 User Guide. Jan. 2008. HP 1st ed. Part number: T4238-96114. pp. 1-83.

Michael DeHaan. "Unfiled Provisioning". 2007.

Michael DeHaan. "Provisioning With Cobbler". 2007.

Tan et al. "A WBEM Basked Disk Array Management Provider". 2005. IEEE. 2005 International Conference on Cyberworlds.

Lovelace et al. Managing Disk Subsystems using IBM TotalStorage Productivity Center. Sep. 2005. IBM. 2nd ed. SG24-7097-01. pp. 1-42.

Doc Searls "Linux for Suits", 2005, Specialized System Consultants Inc., vol. 2005.

eBook "Microsoft System Management Server 2003 Administrator's companion", Microsoft Press, c2004, Ch. 13, Patch Management, pp. 471-507.

Butt et al., "Automated Installation of Large-Scale Linux Networks", 2000.

Agarwalla, "Automating Provisioning of Complete Software Stack in a Grid Environment", 2004.

Anderson et al., "Technologies for Large-Scale Configuration Management", Dec. 9, 2002.

Grosse, "Repository Mirroring", 1995.

Michael DeHaan, "Methods and Systems for Provisioning Software", U.S. Appl. No. 11/763,315, filed Jun. 14, 2007.

Michael DeHaan, "Methods and Systems for Provisioning Software", U.S. Appl. No. 11/763,333, filed Jun. 14, 2007.

DeHaan, "Systems and Methods for Cloning Target Machines in a Software Provisioning Environment", U.S. Appl. No. 12/473,014, filed May 27, 2009.

DeHaan, "Systems and Methods for Providing Configuration Management Services from a Provisioning Server", U.S. Appl. No. 12/414,941, filed Mar. 31, 2009.

DeHaan, "Systems and Methods for Retiring Target Machines by a Provisioning Server", U.S. Appl. No. 12/475,427, filed May 29, 2009.

Henson, "Systems and Methods for Mounting Specified Storage Resources from Storage Area Network in Machine Provisioning Platform", U.S. Appl. No. 12/627,988, filed Nov. 30, 2009.

Henson, "Systems and Methods for Integrating Storage Resources from Storage Area Network in Machine Provisioning Platform", U.S. Appl. No. 12/628,041, filed Nov. 30, 2009.

* cited by examiner

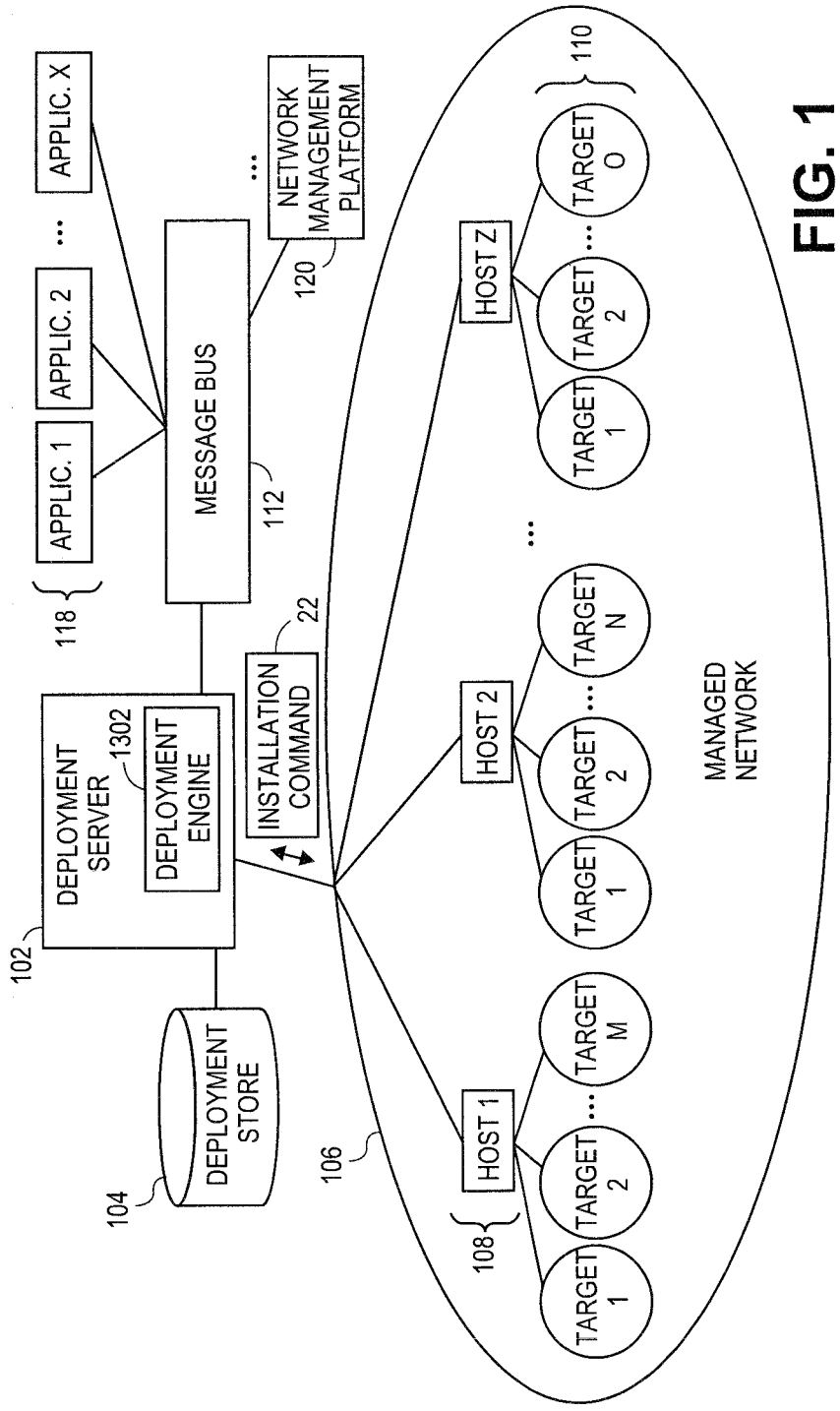

APPLIC. X
APPLIC. 2
APPLIC. 1
118
MESSAGE BUS
112
NETWORK MANAGEMENT PLATFORM
120
22
INSTALLATION COMMAND
DEPLOYMENT SERVER
1302
DEPLOYMENT ENGINE
102
DEPLOYMENT STORE
104
106
HOST 1
HOST 2
HOST Z
TARGET 1
TARGET 2
TARGET M
TARGET N
TARGET O
108
110
MANAGED NETWORK

FIG. 1

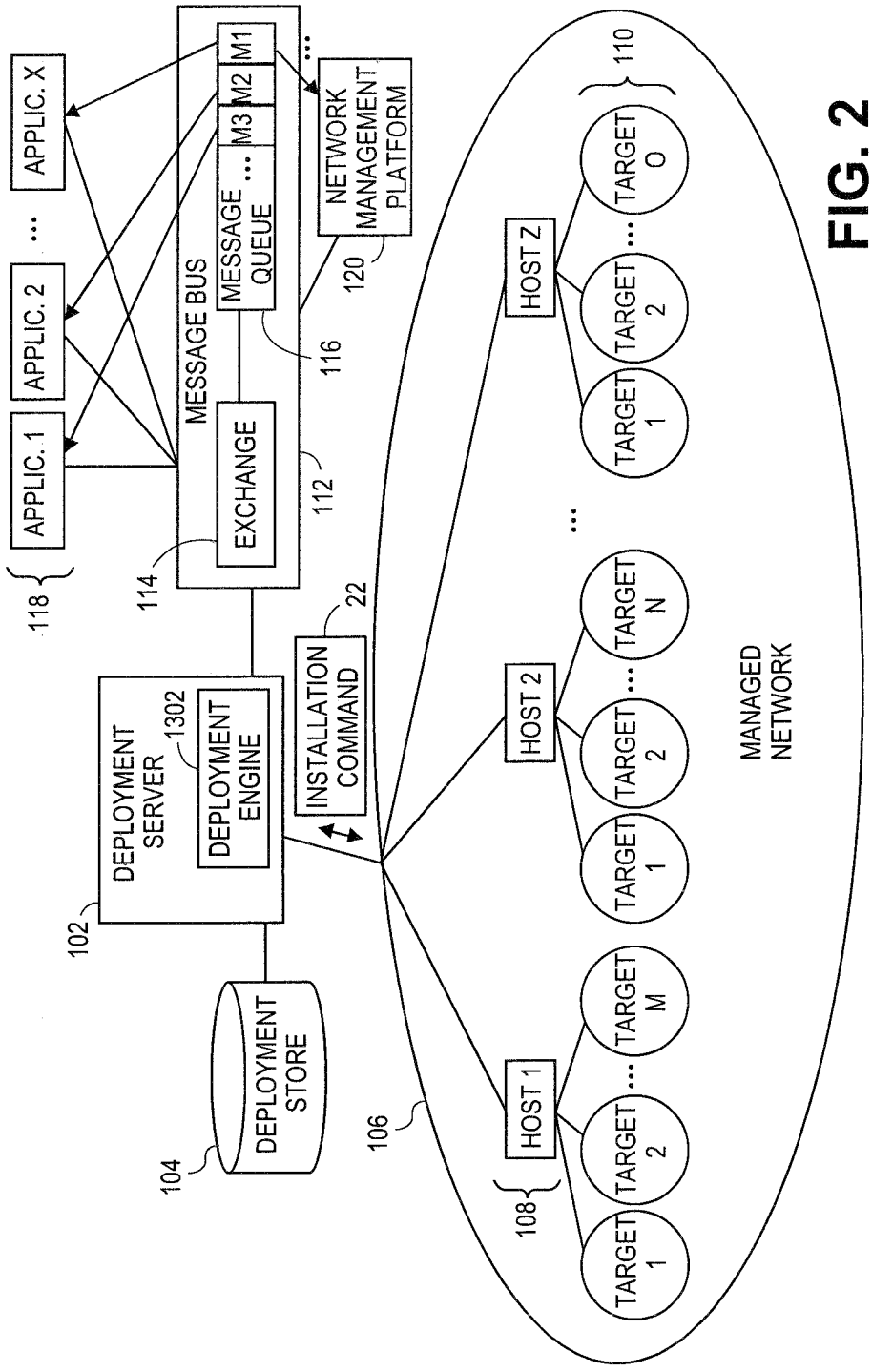

APPLIC. X
APPLIC. 2
APPLIC. 1
118
MESSAGE BUS
M1
M2
M3
MESSAGE QUEUE
EXCHANGE
114
112
116
NETWORK MANAGEMENT PLATFORM
120
DEPLOYMENT SERVER
1302
DEPLOYMENT ENGINE
102
INSTALLATION COMMAND
22
DEPLOYMENT STORE
104
106
HOST 1
HOST 2
HOST Z
108
110
TARGET 1
TARGET 2
TARGET M
TARGET N
TARGET O
MANAGED NETWORK

FIG. 2

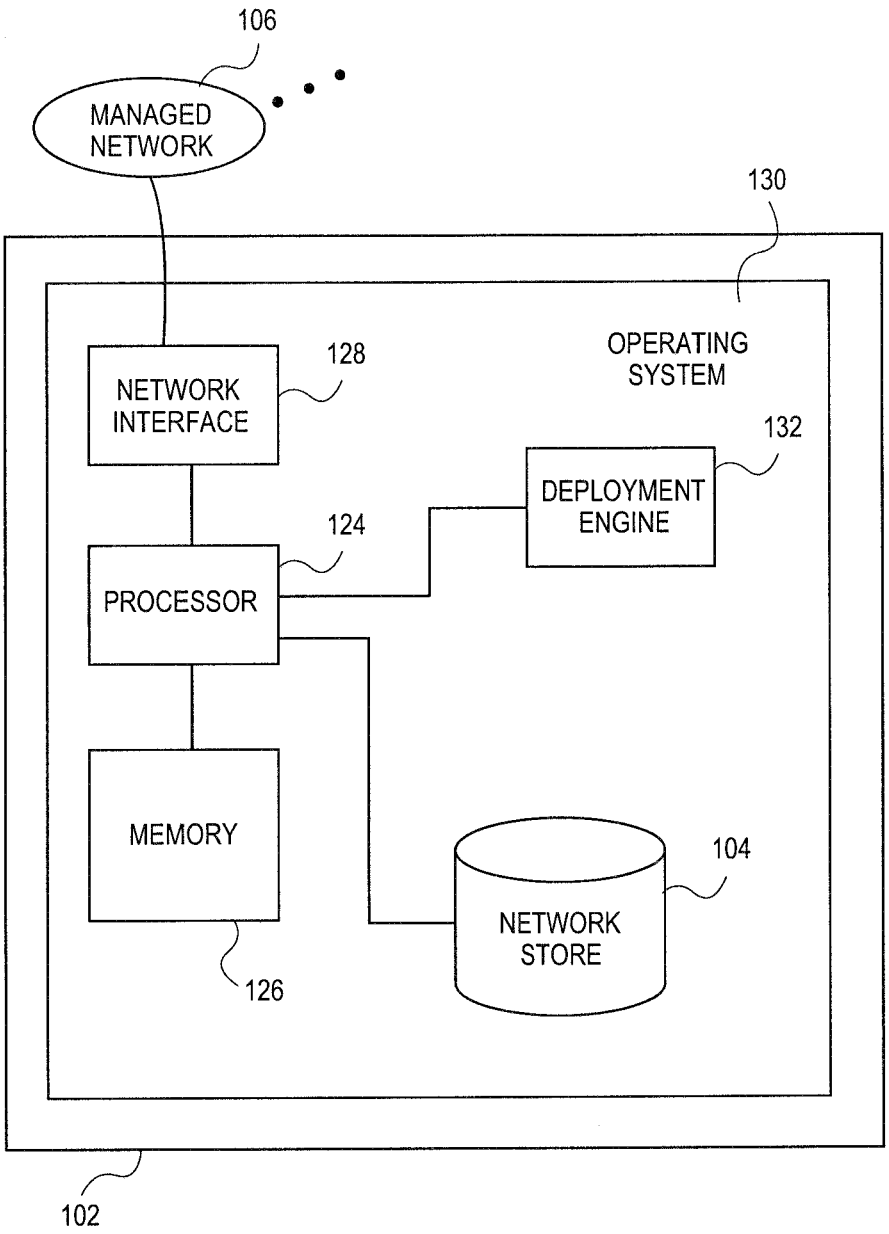

106
MANAGED NETWORK
130
OPERATING SYSTEM
128
NETWORK INTERFACE
132
DEPLOYMENT ENGINE
124
PROCESSOR
MEMORY
126
104
NETWORK STORE
102

FIG. 3

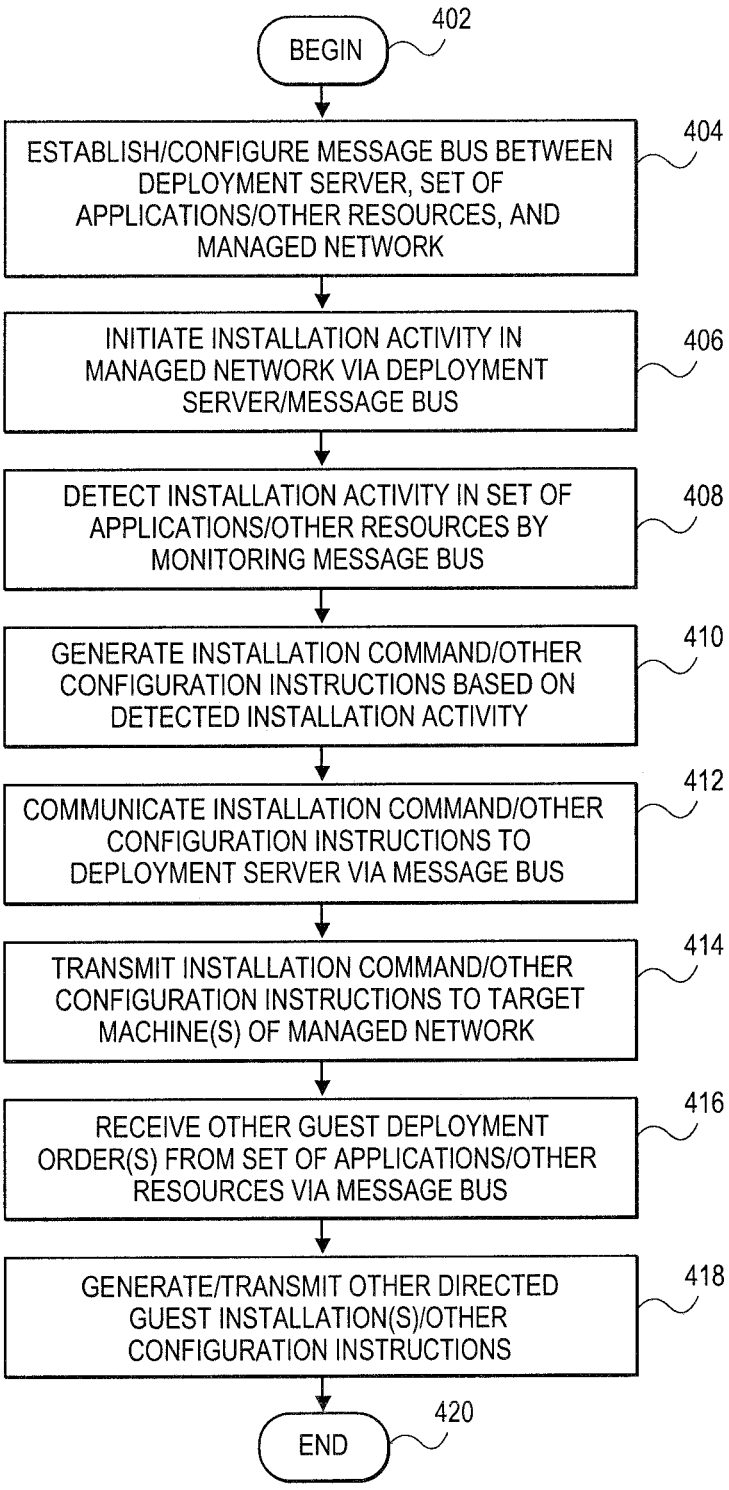

BEGIN
402
ESTABLISH/CONFIGURE MESSAGE BUS BETWEEN DEPLOYMENT SERVER, SET OF APPLICATIONS/OTHER RESOURCES, AND MANAGED NETWORK
404
INITIATE INSTALLATION ACTIVITY IN MANAGED NETWORK VIA DEPLOYMENT SERVER/MESSAGE BUS
406
DETECT INSTALLATION ACTIVITY IN SET OF APPLICATIONS/OTHER RESOURCES BY MONITORING MESSAGE BUS
408
GENERATE INSTALLATION COMMAND/OTHER CONFIGURATION INSTRUCTIONS BASED ON DETECTED INSTALLATION ACTIVITY
410
COMMUNICATE INSTALLATION COMMAND/OTHER CONFIGURATION INSTRUCTIONS TO DEPLOYMENT SERVER VIA MESSAGE BUS
412
TRANSMIT INSTALLATION COMMAND/OTHER CONFIGURATION INSTRUCTIONS TO TARGET MACHINE(S) OF MANAGED NETWORK
414
RECEIVE OTHER GUEST DEPLOYMENT ORDER(S) FROM SET OF APPLICATIONS/OTHER RESOURCES VIA MESSAGE BUS
416
GENERATE/TRANSMIT OTHER DIRECTED GUEST INSTALLATION(S)/OTHER CONFIGURATION INSTRUCTIONS
418
END
420

FIG. 4

MESSAGE-BASED INSTALLATION MANAGEMENT USING MESSAGE BUS

FIELD

The present teachings relate to systems and methods for message-based installation management using a message bus, and more particularly to platforms and techniques for initiating, monitoring, and managing installation events generated by a deployment server connected to applications, targets, and other resources in a managed network via a message bus.

BACKGROUND OF RELATED ART

Distribution servers and other deployment platforms are available for managed network applications which configure the distribution of software to target machines on a network-wide basis. In available deployment platforms, a distribution server can be set up to communicate with the target machines or other nodes of a managed network, and initiate the delivery and installation of software to those nodes. In cases, the provisioning may be the original operating system installation for a new machine, or may be software updates, including operating system or application updates, to existing targets or other hardware.

In conventional deployment platforms, the distribution server can act as a repository for the software images needed for software installations, and communicate with the target machines via application programming interfaces (APIs) and connections to supervisory hosts or target machines which are prepared to receive the installation. However, deployment platforms as currently implemented can involve certain drawbacks or limitations. For one, in general for existing deployment platforms to conduct installation activity, a set of messages must be sent on a point-to-point basis between some type of provisioning server and recipient hosts or targets. That is, installation events depend and take place based on positive communication events between deployment servers and nodes in the managed network. There is no capability in such networks for the ongoing monitoring or surveillance of all installation-related activity. As a result, for example, applications or application servers or other entities which may wish to prepare an installation package for newly-installed machines may not become aware of the existence of newly instantiated machines until a separate command arrives addressed to them that notifies them of that event. For another, in general existing deployment platforms rely upon a set of installation-related commands called via a defined API, which requires that all participating targets and other nodes in the network be configured to interpret that API. As a result, clients, devices, or other machines introduced into the managed network that do not host that API may be unable to receive installation-related services. It may be desirable to provide methods and systems for message-based installation management using a message bus, in which provisioning requests and events can be deployed as universal services across a managed network.

DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate embodiments of the present teachings and together with the description, serve to explain the principles of the present teachings. In the figures:

FIG. **1** illustrates an overall network in which systems and methods for message-based installation management using a message bus can be implemented, according to various embodiments;

FIG. **2** illustrates an overall network in which systems and methods for message-based installation management using a message bus can implemented, according to various embodiments in further regards;

FIG. **3** illustrates an exemplary hardware configuration of a deployment server and associated resources, according to various embodiments; and

FIG. **4** illustrates a flowchart of installation processing that can be used in systems and methods for message-based installation management using a message bus, according to various embodiments.

DESCRIPTION OF EMBODIMENTS

Embodiments of the present teachings relate to systems and methods for message-based installation management using a message bus. More particularly, embodiments related to platforms and techniques for monitoring a message bus connected between a deployment server, managed network, set of applications, and other resources to detect the occurrence of installation events, such as the installation of an operating system and/or the instantiation of a virtual machine.

When installation events occur, applications or other logic can generate additional messaging to initiate further installation sequences, or to cause other provisioning, configuration, or management activity in the target machines. In embodiments, applications, network management platforms, and other network entities can likewise generate installation-related message commands that do not depend on detection of an in-process installation event, such as periodic software updates or refreshes. Because applications and other logic can subscribe to or monitor the installation-related traffic taking place on the message bus, installation services can be flexibly configured amongst multiple nodes and resources, without a need for point-to-point calls relying upon programmatic API commands. These and other embodiments described herein address the various noted shortcomings in known provisioning technology, and provide a user or network operator with enhanced installation services.

Reference will now be made in detail to exemplary embodiments of the present teachings, which are illustrated in the accompanying drawings. Where possible the same reference numbers will be used throughout the drawings to refer to the same or like parts.

FIG. **1** illustrates an overall network **100** in which systems and methods for message-based installation management using a message bus can be implemented, according to various embodiments of the present teachings. In embodiments as shown, a deployment server **102** can communicate with a managed network **106** to carry out various installation, provisioning, deployment, or associated services. In embodiments, deployment serve **102** can communicate with managed network **106** via secure or non-secure channels or connections, including, for instance, the Internet or other public or private networks. In embodiments, deployment server **102** can host, maintain, or communicate with a set of associated resources including a deployment store **104**, which can be or include a local or remote database or data store hosting installation code, scripts, tables, profiles, authentication data, and other data or resources related to installation activity in managed network **106** or other networks or destinations. In embodiments, deployment server **102** can be or include a server, platform, and/or related

resources such as those described in copending U.S. patent application Ser. No. 11/763,315, U.S. Patent Application Publication No. 2008/0288938 and U.S. patent application Ser. No. 11/763,333, U.S. Patent Publication No. 2008/0288939, the disclosures of which are incorporated herein, in their entirety, by reference. In embodiments, deployment server **102** can comprise, host, or access a deployment engine **132** containing applications, logic, and/or other resources to generate, filter, route, and manage installation-related messages, commands, and/or data to managed network **106**.

Managed network **106** can include or host a set of resources including a set of hosts **108**, a set of targets **110**, and/or other nodes, machines, or resources. In embodiments, either of set of hosts **108**, set of targets **110**, and/or other nodes or resources of managed network **106** can be or include virtual machines, as well as hardware-based or hardware-implemented machines. In embodiments, set of hosts, set of targets **110**, and/or other resources of managed network **106** can be or include resources instantiated from or based on cloud-based networks.

In embodiments as likewise shown, deployment server **102** as well as other resources or entities can be connected to, or communicate with, a message bus **112**. In embodiments, message bus **112** can be exposed to deployment server, managed network **106**, and/or other nodes or resources on a direct basis without a necessity for an intermediate application programming interface (API). In embodiments, message bus **112** can be or include a message bused based on the Advanced Message Queuing Protocol (AMQP). In embodiments message bus **112** can be or include, for instance, the Red Hat Enterprise MRG platform implementing an AMQP-based message bus, available from Red Hat Inc., Raleigh, N.C. Other AMQP-based or other message bus architectures can be used. In general, message bus **112** can receive and publish messages on a many-to-many, one-to-many, or other distribution basis.

In embodiments as shown, message bus **112** also be connected to or communicate with a set of applications **118**, such as supervisory, management, communications, and/or other applications. Set of applications **118** can in embodiments be hosted or execute in associated servers or other hosts. Message bus **112** can further be connected to one or more network management platform **120**, such as a network controller or network security server. Other nodes, servers, entities, services, or resources can be connected or registered to message bus **112**, which again, can configured to receive messages or commands from all connected entities without invoking any specific application programming interface (API), and/or without requiring structured or rigidly structured message formats.

In terms of installation management, in embodiments as shown set of applications **118**, one or more network management platform **120**, and/or other services or resources can subscribe to message bus **112** and monitor message traffic over that bus to detect installation events that may be initiated by or via deployment server **102**. For example, set of applications **118** can detect the initiation of installation processes conducted on a set of virtual machine as part of set of targets **110**. The installation activity can be identified, for instance, by the type of instructions or data being passed from deployment server **102** to set of targets **110** or other destination. Upon detection of an installation event, one or more application in set of applications **118** can transmit one or more installation command **122** to deployment server **102** based on the detected installation activity. In embodiments, for instance, one or more application in set of applications **118** can transmit one or more installation command **122** to deployment server **102** indicating that a set of applications, such as database or messaging applications, should be installed upon completion of the operating system installation in set of hosts **108** and/or set of targets **110**. One or more installation command **122** can then be communicated, or associated commands or installations can be executed, on the desired node, resource, or machine in managed network **106**. In embodiments, other applications in set of applications **118**, one or more network management platform **120**, and/or other resources can similarly transmit one or more installation command **122** to deployment server **102**, for instance, in response to an original installation event. In embodiments, one or more installation command can also or instead be transmitted from set of applications **118**, one or more network management platform **120**, and/or other resources at other times or based on other conditions which may or may not be based on installation events. For instance, one or more applications in set of applications **118** can transmit one or more installation command **122** to deployment server **102** based on a predetermined schedule, for instance, to update installed applications on a regular basis. Other conditions can be used. For instance, one or more installation command **122** can be triggered by the detection of message activity on message bus **112** from other applications in set of applications **118**, for instance, to generate a succession of software installations to set of hosts **108**, set of targets **110**, and/or other nodes or destinations, in dependency order. Other triggering events or message criteria can be used.

More particularly, and as for example shown in FIG. **4**, deployment server **102** can be connected to and communicate with managed network **106**, set of applications **118**, network management platform **120**, and/or other nodes or resources via message bus **112**. In embodiments, message bus **112** can comprise an exchange **112**, such as a server or other resource, to which messages from any participating node or other source can be transmitted. Exchange **112** can comprise logic to receive message traffic from deployment server **102**, set of applications **118**, network management platform **120**, and/or other nodes or resources and insert received messages into one or more message queue **116**. Message queue **116** can temporarily store message traffic and delivery messages to destination nodes or resources including deployment server **102**, set of applications **118**, one or more management platform **120**, and managed network **106** along with any of its constituent nodes. In embodiments, for example, any or more of set of applications **118** can subscribe to message events generated by deployment server **102** and transmitted to, for instance, set of hosts **108** and/or set of targets **110**. In embodiments, nodes or other resources which monitor message traffic communicated by way of exchange **114** can registered to receive that traffic on a subscription or other basis, so that those recipients can monitor ongoing message flows without a need to communicate via an API or other programmatic interface. Upon detection of predetermined message events or at other times, set of applications **118** and/or other nodes or entities can transmit one or more installation command **122** to deployment server **102**. One or more installation command **122** can likewise be communicated via message bus **112**, including exchange **114**, one or more message queue **116**, and/or other resources, interfaces, or facilities associated with message bus **112**. While embodiments are shown in which message bus **112** contains at least one exchange **112** and one or more message queue **116**, it will be appreciated that other communications resources and architectures can be used by or hosted in message bus **112**. It may be further noted that one or more installation command **122**, as well as other message types or content, can be transmitted via message bus **122** in various configurations. For instance, a message transmitted to

message bus **112** can, for instance, be sent to one destination from one source, to multiple destinations from one source, from multiple destinations from one source, and/or multiple destinations from multiple sources. One or more installation command **122** and/or other message traffic can likewise be transmitted from one or more sources to one or more destinations in sequence, in daisy-chain fashion.

FIG. **3** illustrates an exemplary diagram of hardware and other resources that can be incorporated in a deployment server **102** configured to communicate with managed network **106** including set of hosts **108**, set of target **110**, message bus **112**, and/or other resources, according to embodiments. In embodiments as shown, the deployment server **102** can comprise a processor **124** communicating with memory **126**, such as electronic random access memory, operating under control of or in conjunction with operating system **130**. Operating system **130** can be, for example, a distribution of the Linux™ operating system, the Unix™ operating system, or other open-source or proprietary operating system or platform. Processor **124** also communicates with a deployment store **104**, such as a database stored on a local hard drive. Processor **124** further communicates with network interface **128**, such as an Ethernet or wireless data connection, which in turn communicates with one or more managed network **106**, which can be, include, or be accessed with via private or secure channels, and/or the Internet or other public or private networks. Processor **124** also communicates with deployment engine **132** and/or other resources or logic, to execute control, messaging, installation, and other management processes described herein. Other configurations of the deployment server **102**, associated network connections, and other hardware and software resources are possible. While FIG. **3** illustrates deployment server **102** as a standalone system comprises a combination of hardware and software, deployment server **102** can also be implemented as a software application or program capable of being executed by a conventional computer platform. Likewise, deployment server **102** can also be implemented as a software module or program module capable of being incorporated in other software applications and programs. In either case, deployment server **102** can be implemented in any type of conventional proprietary or open-source computer language.

FIG. **4** illustrates a flowchart of overall processing that can be used in systems and methods for message-based installation management using a message bus, according to various embodiments. In **402**, processing can begin. In **404**, message bus **112** can be established and/or configured between deployment server **102**, set of applications **118**, management platform **120**, and/or other resources, and managed network **106**. In **406**, installation activity in managed network **106** can be initiated via deployment server **102**, message bus **112**, and targets or other resources of managed network **106**. In embodiments, the installation activity can be or include operating system, application, or other installations to set of hosts **108**, set of targets **110**, and/or other clients, devices, and/or resources of managed network **106**. In **408**, set of applications **118**, management platform **120**, and/or other entities or resources can detect the installation activity conducted by deployment server **102** by monitoring message bus **112**, and for instance detecting commands indicating or representing the initiation or execution of installation, provisioning, or other activities.

In **410**, set of applications **118**, management platform **120**, and/or other entities or resources can generate one or more installation command **122** based on the detected installation activity taking place over message bus **112**. For instance, upon detection of the installation of operating system software on a given subset of set of targets **110**, set of applications **118** can initiate the installation of identified application software, communication services, and/or other software or services. In **412**, the set of applications **118**, management platform **120**, or other entity or resources can communicate the resulting one or more installation command **122** to deployment server **102** via message bus **112**. In **414**, deployment server **102** can transmit the one or more installation command **122** and/or other configuration instructions to one or more target machine in managed network **106**, such as one or more servers of other hosts in set of hosts **108**, and/or one or more clients or other targets in set of targets **110**.

In **416**, deployment server **102** can receive one or more other installation command **122** or other guest deployment order from set of applications **118**, management platform **120**, and/or other entities or resources via message bus **112**. For instance, an application in set of applications **118** may direct the installation of a set of applications that are not associated or directly associated with an installation event, such as installations based on periodic software updates or patches. In **418**, deployment server **102** can generate and/or transmit the additional one or more installation command **122** or other directed guest installation(s) or configuration instructions to target machines or resources in managed network **106**. In **420**, processing can repeat, return to a prior processing point, jump to a further processing point, or end.

The foregoing description is illustrative, and variations in configuration and implementation may occur to persons skilled in the art. For example, while embodiments have been described which operate in a network incorporating one deployment server **102** communicating with managed network **106**, set of applications **118** and other resources via one message bus **112**, in embodiments, more than one deployment server or host can be used. Likewise, in embodiments more than one message bus can be implemented to provide communications between one or more deployment servers, applications, target machines, and/or other resources. Other resources described as singular or integrated can in embodiments be plural or distributed, and resources described as multiple or distributed can in embodiments be combined. The scope of the present teachings is accordingly intended to be limited only by the following claims.

What is claimed is:

1. A method, comprising:

establishing a message bus between a deployment server and a resource;

monitoring, by a processor, the message bus to detect a first installation activity; and

generating by the processor, an installation command to cause a second installation activity in a managed network in view of the first installation activity detected on the message bus.

2. The method of claim **1**, wherein the managed network comprises at least one of a set of hosts or a set of targets.

3. The method of claim **2**, wherein the at least one of a set of hosts or a set of targets comprises at least one of a set of virtual machines or a set of hardware-implemented machines.

4. The method of claim **3**, wherein the first installation activity comprises a first software installation to a plurality of the hosts or targets in the at least one of a set of hosts or a set of targets.

5. The method of claim **1**, wherein at least one of the deployment server, an application, or a node of the managed network subscribe to a message queue.

6. The method of claim **5**, further comprising generating a message from the deployment server to at least one of the

application or node of the managed network indicating a status of an installation process.

7. The method of claim **5**, wherein the subscription to the message queue is based on a one-to-many configuration.

8. The method of claim **1**, wherein the resource comprises an application, the managed network, and a network management platform.

9. The method of claim **1**, wherein the first installation activity comprises an installation an operating system, and wherein the second installation activity comprises an installation of a set of software applications to the operating system.

10. The method of claim **1**, wherein the first installation activity in the managed network is deployed as a universal service across the managed network.

11. A system, comprising:

an interface to a resource; and

a deployment server, to communicate with the resource via the interface, the deployment server comprising a processor to:

access a message bus between the deployment server and the resource to detect a message activity that is related to an installation event,

receive an installation command to cause a software installation in a managed network via the message bus, and

initiate the software installation via the message bus after the installation event.

12. The system of claim **11**, wherein the managed network comprises at least one of a set of hosts or a set of targets.

13. The system of claim **12**, wherein the at least one of a set of hosts or a set of targets comprises at least one of a set of virtual machines or a set of hardware-implemented machines.

14. The system of claim **13**, wherein the software installation comprises a software installation to a plurality of the hosts or targets in the at least one of a set of hosts or a set of targets.

15. The system of claim **11**, wherein the message bus comprises an exchange and a message queue.

16. The system of claim **15**, wherein at least one of the deployment server, a set of applications, or a node of the managed network subscribe to the message queue.

17. The system of claim **16**, the processor further to generate a message from the deployment server to at least one of the set of applications or node of the managed network indicating a status of an installation process.

18. The system of claim **16**, wherein the installation commands are received in view of detected installation events in the managed network.

19. The system of claim **18**, wherein the subscription to the message queue is based on a one-to-many configuration.

20. The system of claim **11** wherein the software installation comprises an installation of at least one of an operating system or an application.

21. A non-transitory computer readable storage medium comprising instructions that, in response to execution by a processor, cause the processor to:

establish a message bus between a deployment server and a resource;

monitor the message bus to detect a message with a first installation activity; and

generate, by the processor, an installation command to cause a second installation activity in a managed network, in view of the message detected on the message bus.

22. The non-transitory computer readable storage medium of claim **21**, wherein the first installation activity comprises an installation an operating system, and wherein the second installation activity comprises an installation of a set of software applications to the operating system.

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